Highway Traffic Noise Analysis

PIN 17592.00
Augusta: I-95 East-West Connections Environmental Assessment

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CONTENTS

INTRODUCTION

This highway traffic noise analysis was prepared to determine the potential noise impacts associated with the transportation alternatives presented the in Augusta I-95 East-West Connections Environmental Assessment (EA). The highway traffic noise levels were predicted for the existing condition (2008) and the future No-Build and Build Alternatives for the design year (2028).

The noise analysis was conducted in accordance with the following Federal Highway Administration (FHWA) and Maine Department of Transportation (MaineDOT) regulatory and policy guidelines:

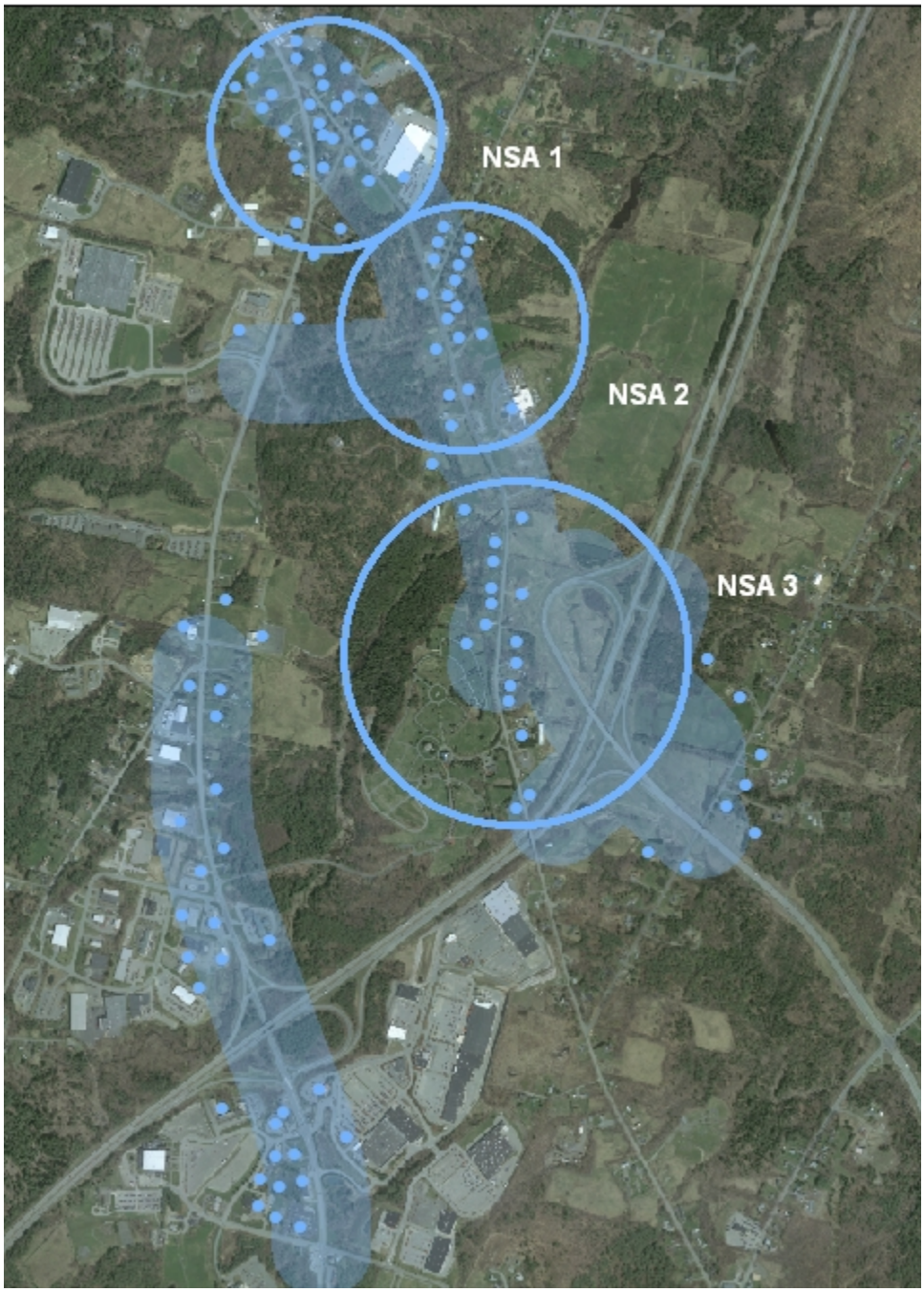
- Title 23 Code of Federal Regulations Part 772 Procedures for Abatement of Highway Traffic Noise and Construction Noise. (23 CFR 772);
- FHWA Highway Traffic Noise and Abatement Policy and Guidance, June 1995, and;
- MaineDOT Highway Traffic Noise Policy, May 2008.

The purpose of a highway traffic noise analysis is to identify impacted land uses (homes, schools, business, etc) and determine the feasibility and reasonableness of abatement measures. The terms “feasibility” and “reasonableness” are terms commonly used in highway traffic noise analysis to determine, among other things, the effectiveness (in terms of noise reduction) and the acceptable cost for any noise abatement measure. All noise abatement measures are evaluated based on the feasibility and reasonableness criteria identified in MaineDOT’s noise policy.

1.0 STUDY AREA

Figure 1-1 illustrates the study area for the noise analysis. MaineDOT's noise policy establishes a study area with a distance of 500' from the edge of pavement for a proposed highway project.

Figure 1-1 Highway Traffic Noise Analysis Study Area



The EA presents several build alternatives and a no-build alternative along Civic Center Drive at Exit 112 and along Old Belgrade Road at Exit 113. For the purposes of this analysis, the noise study area extends 500' into commercial areas and residential neighborhoods located along Civic Center Drive and Old Belgrade Road.

2.0 NOISE ABATEMENT CRITERIA

The FHWA and MaineDOT Noise Abatement Criteria (NAC) were used to determine traffic noise impacts at all receivers within the study area. The NAC are FHWA-established noise levels for activities or land uses that identify traffic noise impacts during the loudest hour. As shown in Table 2-1, the criteria vary according to a property's activity category. Weekday afternoon peak-hour traffic data was used to replicate loudest hour conditions

MaineDOT evaluates noise abatement measures when predicted future noise levels "approach" within 1 dBA or "exceed" the NAC; thus abatement measures will be evaluated for any residential homes (NAC Activity Category B) with predicted noise levels of 66 dBA or greater.

Table 2-1 Noise Abatement Criteria (NAC)

Activity Category	Leq(h) dBA	Description of Activity Category
A	57 Exterior	Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose.
B	67 Exterior	Picnic areas, recreation areas, playgrounds, active sports areas, parks, residences, motels, hotels, schools, churches, libraries, and hospitals.
C	72 Exterior	Developed lands, properties, or activities not included in Categories A or B above.
D	----------	Undeveloped lands.
E	52 Interior	Residences, motels, hotels, public meeting rooms, schools, churches, libraries, hospitals, and auditoriums.

3.0 METHODOLOGY

Noise levels were established using a combination of traffic noise modeling and field measurements for the existing conditions (2008) and future (2028) no-build and build conditions. The results of the noise analysis are presented in Section 4.

The prediction of traffic noise levels was performed using FHWA's computer model for highway traffic noise prediction and analysis – the Traffic Noise Model Version 2.5 (TNM 2.5). TNM 2.5 predicts traffic noise levels between highways and nearby receivers taking the intervening ground's acoustical characteristics, topography, and rows of buildings into account.

The noise levels presented in this report are expressed in decibels (dB) on the A-weighted scale (dBA). This scale most closely approximates the response characteristics of the human ear to low level sound. All noise levels are reported as equivalent level, Leq(h), values which contain the same amount of acoustic energy as an actual time-varying A-weighted sound level over a period of 1 hour.

Traffic data for I-95, Route 3, Old Belgrade Road, Civic Center Drive and surrounding streets were obtained from the Draft Exit 113 Interstate Access Justification Report and MaineDOT's Traffic Analysis section. Traffic volumes for the weekday afternoon peak-hour (4:30-5:30 PM) were chosen to represent loudest hour conditions. Land use, elevation and highway data were obtained from readily available CADD images, aerial photography, and MaineDOT's TIDE (Transportation

Information for Decision Enhancement) database. Property data was obtained from the City of Augusta Assessor's records.

Noise measurements were performed on November 16th, December 18th, and December 22nd, 2009. These measured noise levels were used to validate the accuracy of TNM 2.5 calculations.

4.0 NOISE ANALYSIS

The traffic noise analysis was performed using TNM 2.5. The model was validated using actual field measurements from Type II Quest Sound Level Meters. The purpose of the noise analysis was to predict existing noise levels and determine noise impacts for all receivers within the study area. The Feasibility and Reasonableness of noise abatement was then evaluated for all impacted receivers based upon criteria contained in the MaineDOT's Highway Traffic Noise Policy.

4.1 Receivers

A "receiver" is a technical term used to describe the location of any properties included in the noise analysis. In determining traffic noise impacts, primary consideration is given to exterior areas where frequent human use occurs such as patios, porches, swimming pools, playgrounds, etc. If no exterior areas are present, the interior NAC is used as the basis for determining noise impacts.

Various factors affect the "transmittal" of sound from a source to a receiver. These factors include vegetation, intervening structures, elevation of the source and/or the receiver, surrounding topography and the type of ground surface between the source and the receiver. The attenuation (reduction) of sound levels due to intervening structures occurs when a receiver's view (line-of-sight) is obstructed or partially obstructed by dense objects (i.e. rows of buildings, barriers, etc).

A total of 103 receivers were analyzed within the study area. NAC Activity Categories B and C were used to identify noise impacts for all receivers in the study area. The location of each of receiver is shown in Appendix A.

4.2 Noise Sensitive Areas

Three Noise Sensitive Areas (NSAs) were identified in the study area. NSAs are defined as existing or future planned residential development likely to be affected by traffic noise from the proposed project. Generally, NSAs are identified and delineated by changes in traffic conditions, roadway configurations, topography, and community boundaries. Figure 1-1 on page 2 illustrates the NSAs for the noise analysis.

The 3 NSAs identified in the Study Area are:

NSA-1 is comprised of a rural residential area adjacent to the intersection of Old Belgrade Road and Bog Road. Traffic on Civic Center Drive and Old Belgrade Road is the primary source of noise in NSA-1.

NSA-2 is comprised of a rural residential area adjacent to the intersection of Old Belgrade Road and Middle Road. Traffic on Old Belgrade Road is the primary source of noise in NSA-2.

NSA-3 is comprised of a rural residential area along Old Belgrade Road and adjacent to the I-95 Exit 113 southbound ramps. Traffic noise from I-95 and Exit 113 southbound ramps is the primary source of noise in NSA-3.

4.3 Highway Traffic Noise Model Validation

Traffic noise model validation is typically done as an initial step in traffic noise modeling to insure that predictions of existing and future traffic noise are reasonably accurate. Essentially, modeled results of existing traffic conditions are compared with measured noise levels at various receiver locations. Generally, if modeled noise levels are within ± 3 dBA of measured levels, no additional modifications to the traffic noise model are necessary.

Noise measurements were performed on November 16th, December 18th, and December 22nd, 2009 for selected receivers throughout the study area. These measured noise levels were compared to modeled levels to validate the accuracy of TNM 2.5 predictions. Table 4-2 shows the results of this analysis.

Table 4-1 Results of Traffic Noise Model Validation (dBA)

Receiver ID	Location	Property Description	Measured Noise Levels	Modeled Noise Levels	Difference
112-5	University Drive	Park	56	55	1
112-14	26 Anthony Avenue	Office Building	58	59	1
112-17	281 Civic Center Drive	Hotel	56	58	2
113-17	236 Old Belgrade Road	Veteran's Cemetery	55	56	1
				Average Difference	1

As shown in Table 4.1, the average difference between modeled and measured results for all measurement locations was within ± 3 dBA of measured levels. These results indicate that the traffic noise model is predicting accurately for existing and future conditions.

4.4 Determination of Impacts

Existing Condition (2008)

For the existing condition, noise levels were predicted at 103 receivers throughout the study area. The receiver locations are shown in Appendix A; and the results are tabulated in Table 4-2 (page 7). Several field measurements were also used to validate the accuracy of TNM 2.5 calculations. Weekday afternoon peak-hour traffic noise levels were predicted at each of the receivers within the study area. As shown in Table 4-2, the peak-hour traffic noise levels for the existing condition range from 48 dBA at Receiver 113-40 to 66 dBA at Receivers 113-9, 133-10 and 113-52. Under the existing condition, 3 receivers, representing 4 total units are currently impacted by highway traffic noise.

No-Build Alternative (2028)

The Future No-Build Alternative includes the existing highway network and future 2028 traffic volumes without improvements to Civic Center Drive and Old Belgrade Road, or additional Exit 113 I-95 access. Weekday afternoon peak-hour traffic noise levels were predicted at each of the receivers within the study area. As shown in Table 4-2, the peak-hour traffic noise levels for the no-build alternative range from 51 dBA at Receiver 113-40 to 69 dBA at Receiver 113-9. Under the No-Build Alternative, 15 receivers, representing 17 total units are expected to be impacted by highway traffic noise.

Build Alternative 1 – Exit 113 – Signalized with Old Belgrade Road Upgrade (2028)

The traffic noise analysis for Build Alternative 1 includes additional (westbound) access to Exit 113 and upgrades to Old Belgrade Road with signalized intersections at the termini of the north- and southbound Exit 113 Ramps. Weekday afternoon peak-hour traffic noise levels were predicted at each of the receivers within the study area. As shown in Table 4-2, the peak-hour traffic noise levels for Build Alternative 1 range from 51 dBA at Receiver 113-40 to 68 dBA at Receivers 113-9, 133-10, 133-12 and 113-52. Under Build Alternative 1, 13 receivers, representing 15 total units are expected to be impacted by highway traffic noise.

Build Alternative 2 – Exit 113 – Roundabouts with Old Belgrade Road Upgrade (2028)

The traffic noise analysis for Build Alternative 2 includes additional (westbound) access to Exit 113 and upgrades to Old Belgrade Road with 2-lane roundabouts at the termini of the north- and southbound Exit 113 Ramps. Weekday afternoon peak-hour traffic noise levels were predicted at each of the receivers within the study area. As shown in Table 4-2, the peak-hour traffic noise levels for Build Alternative 2 range from 51 dBA at Receiver 113-40 to 68 dBA at Receivers 113-9, 133-10, and 113-52. Under Build Alternative 2, 13 receivers, representing 15 total units are expected to be impacted by highway traffic noise.

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Table 4-2 Noise Analysis Results (dBA)*

Receiver ID	# of Units	Impact Criteria	Existing 2008 Noise Levels	No-Build 2028 Noise Levels	Build Alt 1 Upgrade with Signals	Build Alt 2 Upgrade with Roundabouts
112-1	1	71	60	62	62	62
112-2	1	71	55	56	56	56
112-3	2	71	54	56	55	55
112-4	2	71	55	57	56	56
112-5	1	66	55	57	57	57
112-6	2	71	60	62	62	62
112-7	1	71	57	60	59	59
112-8	1	71	60	62	62	62
112-9	1	71	62	64	63	63
112-10	2	71	65	67	66	66
112-11	1	66	64	66	66	66
112-12	1	71	59	61	60	60
112-13	1	71	63	66	65	65
112-14	1	71	59	62	61	61
112-15	1	71	63	66	65	65
112-16	2	71	56	59	58	58
112-17	1	66	58	61	60	60
112-18	1	71	63	66	64	64
112-19	1	71	55	58	57	57
112-20	3	71	61	65	64	64
112-21	3	66	59	63	62	62
112-22	3	71	56	60	59	59
112-23	3	66	57	61	60	60
112-24	1	66	56	60	59	59
112-25	3	66	56	60	59	59
112-26	1	66	62	66	65	65
112-27	2	66/71	60	64	64	63
112-28	1	71	50	54	53	53
112-29	1	66	57	62	61	61
113-1	1	66	59	60	61	60
113-2	1	66	57	58	59	58
113-3	1	66	59	60	61	60
113-4	2	66	59	60	61	60
113-5	1	66	54	55	56	55
113-6	1	66	52	53	54	53
113-7	1	66	52	54	56	54
113-8	1	66	56	57	59	58
113-9	1	66	66	69	68	68
113-10	2	66	66	68	68	68
113-11	1	66	61	63	63	63
113-12	1	66	64	68	68	67
113-13	2	66	61	65	65	64
113-14	2	66	59	62	63	62
113-15	1	66	59	61	63	62
113-16	1	71	59	61		
113-17	1	66	56	58	60	59
113-18	1	66	58	62	63	62
113-19	1	66	60	64	62	61
113-20	1	66	60	64	62	61
113-21	1	66	59	63	64	64
113-22	1	66	61	65	66	66
113-23	1	66	57	61	64	63
113-24	1	66	52	54	56	55
113-25	3	66	51	53	54	54
113-26	1	66	55	59	62	62
113-27	1	66	50	53	54	54
113-28	1	66	60	64	66	66
113-29	1	66	60	65	66	66
113-30	2	66	58	63	65	65
113-31	1	66	57	61	64	64
113-32	1	66	49	53	53	53

113-33	1	66	61	66	66	66
113-34	1	66	52	57	60	60
113-35	2	66	59	64	64	64
113-36	1	66	55	60	62	62
113-37	1	66	51	55	56	56
113-38	1	66	50	53	54	54
113-39	1	66	49	52	52	52
113-40	1	66	48	51	51	51
113-41	1	71	54	58	57	57
113-42	1	66	50	54	54	54
113-43	1	66	49	52	51	51
113-44	1	71	50	53	52	52
113-45	3	66	56	60	59	59
113-46	2	66	56	60	59	59
113-47	1	66	54	58	57	57
113-48	7	66	54	57	56	56
113-49	1	66	61	63	63	63
113-50	1	66	64	65	65	65
113-51	1	71	64	66	65	65
113-52	1	66	66	68	68	68
113-53	2	66	56	59	59	59
113-54	1	66	53	54	54	54
113-55	2	66	57	59	59	59
113-56	1	66	50	52	52	52
113-57	1	66	56	58	58	58
113-58	1	66	64	66	66	66
113-59	1	71	60	61	61	61
113-60	1	71	64	66	66	66
113-61	1	66	56	57	57	57
113-62	1	66	51	52	52	52
113-63	1	66	59	60	60	60
113-64	1	66	54	56	55	55
113-65	1	71	59	61	60	60
113-66	1	66	63	65	64	64
113-67	1	66	64	65	65	65
113-68	1	66	65	67	66	66
113-69	1	71	56	59	58	58
113-70	1	71	52	55	54	54
113-71	1	71	60	62	61	61
113-72	1	71	58	61	60	60
113-73	1	71	54	56	56	56
113-74	1	66	59	62	61	61

**Impacted receivers are highlighted in blue*

5.0 EVALUATION OF ABATEMENT ALTERNATIVES

When predicted baseline noise levels “approach” or exceed the NAC, FHWA requires that certain highway traffic noise abatement measures be evaluated. Only the abatement measures that are determined reasonable and feasible are recommended for construction as part of the highway project. The evaluated abatement alternatives include traffic management, alteration of highway alignment, property acquisition, and noise barriers. The feasibility (engineering considerations) and reasonableness (cost benefit) criteria contained in the MaineDOT Highway Traffic Noise Policy were used to evaluate each abatement measure in the following subsections.

5.1 Traffic Management Measures

Traffic management measures that limit motor vehicle speeds and/or reduce volumes can be effective noise abatement measures. However, these measures can also negate a highway’s ability to accommodate current and future traffic volumes. Therefore, reducing traffic speeds and/or traffic volumes is inconsistent with the goal of improving the corridor’s ability to handle the existing and future forecast volumes. As such, traffic management measures, including reducing speed limits or imposing truck restrictions, are not considered feasible and reasonable noise abatement measures.

5.2 Alteration of Highway Alignment

The alteration of horizontal alignment is limited by the available right-of-way along Civic Center Drive and Old Belgrade Road. Significant noise reductions at the study area would require large horizontal alignment shifts which would necessitate additional property takings and could expose additional sites to highway traffic noise. Also, the alteration of the vertical alignment of the existing roadway is not considered to be a feasible noise abatement measure. Depressing Civic Center Drive and Old Belgrade Road is cost prohibitive; elevating the roadway would allow noise to propagate farther into the community at higher levels. Due to the excessive cost and potential right-of-way impacts, the alteration of the vertical or horizontal alignment of Civic Center Drive and Old Belgrade Road is not considered a feasible and reasonable noise abatement measure.

5.3 Property Acquisition

Generally, property acquisition is only considered if additional right-of-way is needed to place a noise barrier. For the purposes of this study, property acquisition was not considered necessary or reasonable for the placement of a noise barrier. Acquisition of property may also be considered, on certain projects, to provide noise buffers for existing or future development. However, the impacted units in the study area generally border Civic Center Drive or Old Belgrade Road; thus, the acquisition of property for a noise buffer is not feasible and reasonable.

5.4 Noise Barriers

Noise barriers reduce noise levels by blocking the sound path between the noise source and the receiver. In order to effectively reduce traffic noise, a noise barrier must be relatively long, continuous (without breaks or openings), and sufficiently tall to provide a reduction in noise levels. Following MaineDOT Highway Traffic Noise Policy procedures, the minimum requirements for a noise barrier to be considered both feasible and reasonable are as follows:

- The barrier must provide at least a 7 dBA reduction at a minimum of 50% of the first row receivers (homes closest to Civic Center Drive or Old Belgrade Road), with 10 dBA or more desired.

- The barrier should not cost more than $30,000 per benefited receiver (a benefited receiver is a site that receives at least a 5 dBA reduction in noise from the barrier). The current estimated cost to construct a noise barrier (materials and labor) is $30.00 per square foot.

Other factors that are considered when evaluating the feasibility and reasonableness of noise barriers include:

- Safety considerations, including maintaining a clear recovery zone along the highway;
- Barrier height;
- Land use (has the municipality adopted appropriate land use strategies adjacent to existing highways to manage development of incompatible activities and avoid future public costs associated with mitigating highway traffic noise impacts);
- The desires of the impacted property owners to have a noise barrier adjacent to their property;
- Proposed project must be eligible for Federal-Aid construction funding; and,
- Other considerations, including but not limited to, maintenance, drainage, snow removal, environmental impacts, and additional construction needs to provide stability within a given topography or geology.

Noise Barrier Analysis

Noise barriers were evaluated for all impacted receivers within the 3 NSAs. The following section summarizes the noise barrier analysis for each NSA.

NSA 1

In NSA-1 there are 4 impacted receivers located along Civic Center Drive. Abating highway traffic noise at these 4 receivers with noise barriers is not feasible because of required access openings for several driveways on Old Belgrade Road and Civic Center Drive. Construction of rear access roads to allow for the placement of a noise barrier is not feasible and reasonable based upon cost and potential ROW impacts.

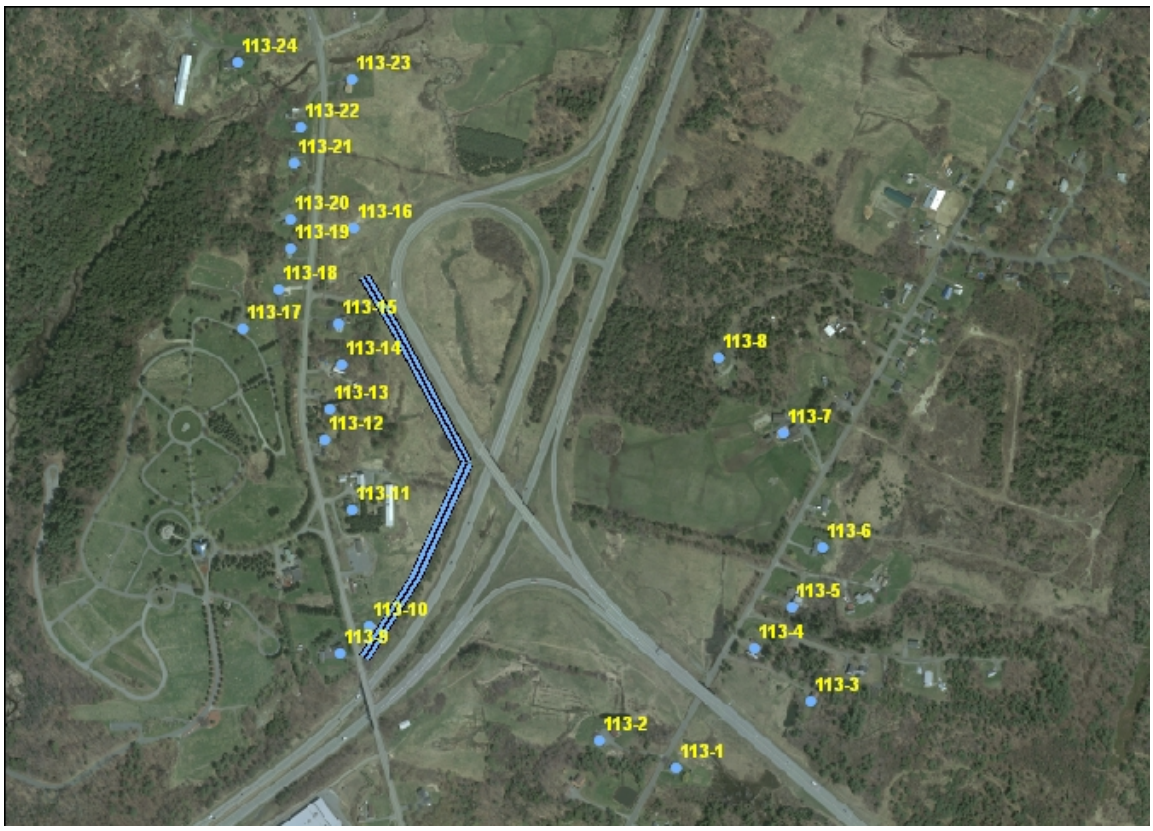
NSA 2

In NSA-2 there are 3 impacted receivers located on Old Belgrade Road. Abating highway traffic noise at these 3 receivers with noise barriers is not feasible because of required access openings for several driveways. Construction of rear access roads to allow for the placement of a noise barrier is not feasible and reasonable based upon cost and potential ROW impacts.

NSA 3

In NSA-3 there are 4 impacted receivers located on Old Belgrade Road. A noise barrier was evaluated for the 4 impacted receivers under the 2028 Build Alternatives. The barrier was evaluated at a length of 2170 feet, located south of the southbound Exit 113 Ramps and west of I-95 southbound. The height of the barrier was 20 feet.

Figure 5-1 Noise Barrier Location



Feasibility

The results of the Feasibility evaluation are provided in Table 5-1. As shown, the barrier provided an average noise reduction of 1 dBA for all receivers and all first row receivers in NSA 3. As noted earlier, MaineDOT's policy requires that a barrier provide at least a 7 dBA reduction at a minimum of 50% of the first row receivers (homes closest to Old Belgrade Road). Based on the results of the study, Barrier 1 does not meet the feasibility criteria contained in MaineDOT's Highway Traffic Noise Policy.

Table 5-1 Noise Barrier Analysis – Feasibility

Name	Avg. Noise Reduction (dBA)		7 dBA Achieved?	**Feasible?**
	All Receivers	First Row Receivers		
Barrier 1	1	1	NO	**NO**

Reasonableness

Barrier reasonableness, which is a measure of cost-effectiveness, is based on an estimated total barrier cost and the number of "benefited" receivers (a receiver predicted to receive at least a 5 dBA reduction in noise from the barrier). To be "reasonable," a barrier cannot cost more than $30,000 per benefited receiver. Costs include but are not limited to costs for barrier materials and installation (estimated at $30 per square foot), for the resolution of utility and drainage conflicts with the barriers, for retrofitting bridges to accommodate noise barriers, and for additional location-specific construction needs (i.e. fill material, riprap and/or retaining wall).

The results of the Reasonableness evaluation are provided in Table 5-2. As shown, the total barrier cost for materials and installation is estimated at $1,300,000. The barrier is predicted to "benefit" 2 dwelling units at a cost of $650,000 per unit. Based on the results of the study, the noise barrier described in Tables 5-1 and 5-2 does not meet the reasonableness criteria contained in MaineDOT's Highway Traffic Noise Policy.

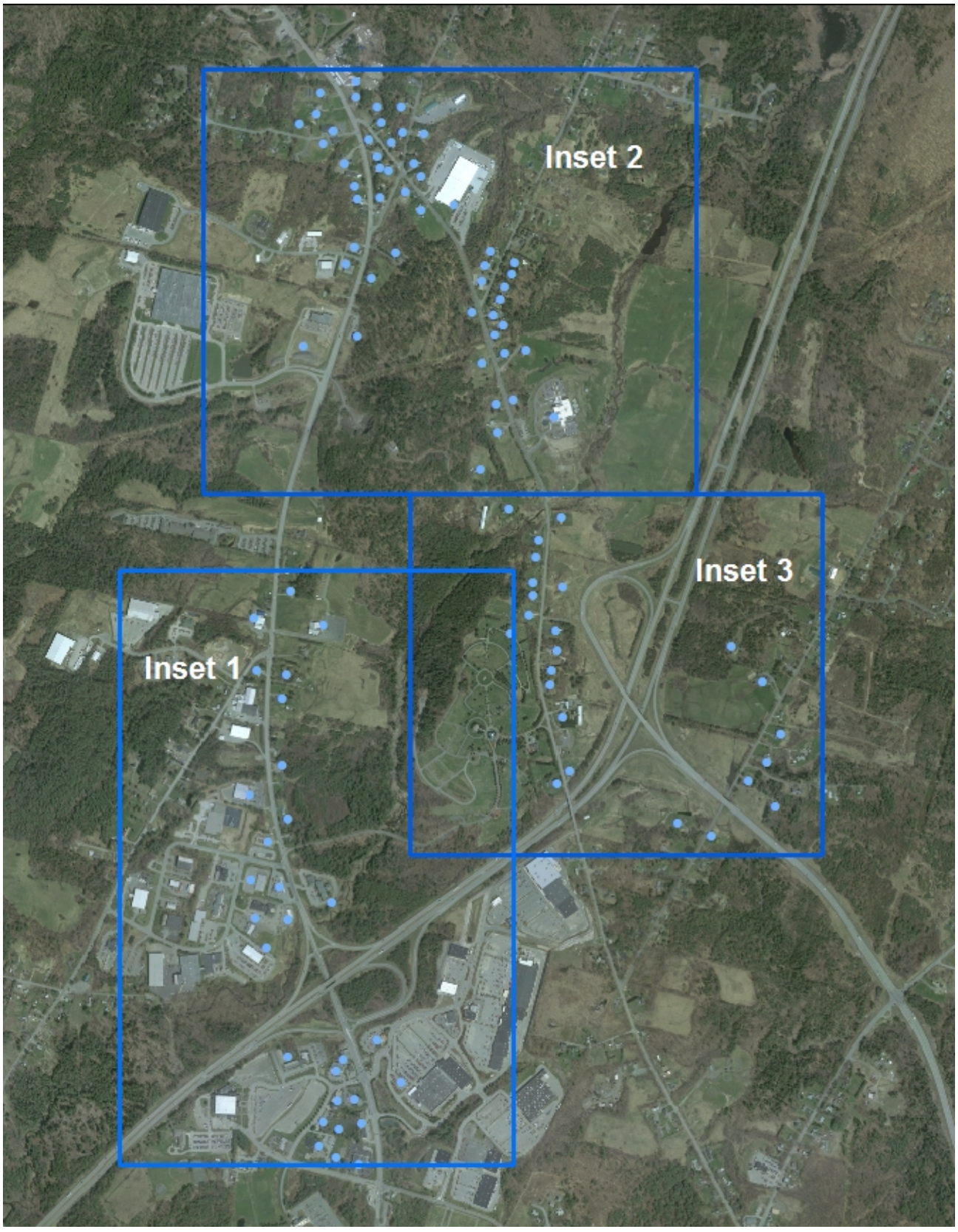
Table 5-2 Noise Barrier Analysis – Reasonableness

Name	Heights along Barrier (ft)			Length (ft)	Estimated Total Cost	Number of Benefited Units	Cost/Unit	**Reasonable?**
	Min	Avg	Max					
Barrier 1	20	20	20	2170	$1,300,000	2	$650,000	**NO**

6.0 CONCLUSION

Noise abatement measures were evaluated for all impacted receivers within the study area. Traffic management, alignment modification, property acquisition, and noise barriers were determined not to be feasible and reasonable methods to reduce the predicted traffic noise levels for the impacted sites.

Appendix A: Receiver Locations



Inset 1: Exit 112

Inset 2: Exit 113 North

Inset 3: Exit 113 South